The Arctic Basin

Results from the Russian Drifting Stations

Ivan E. Frolov, Zalman M. Gudkovich,
Vladimir F. Radionov, Alexander V. Shirochkov
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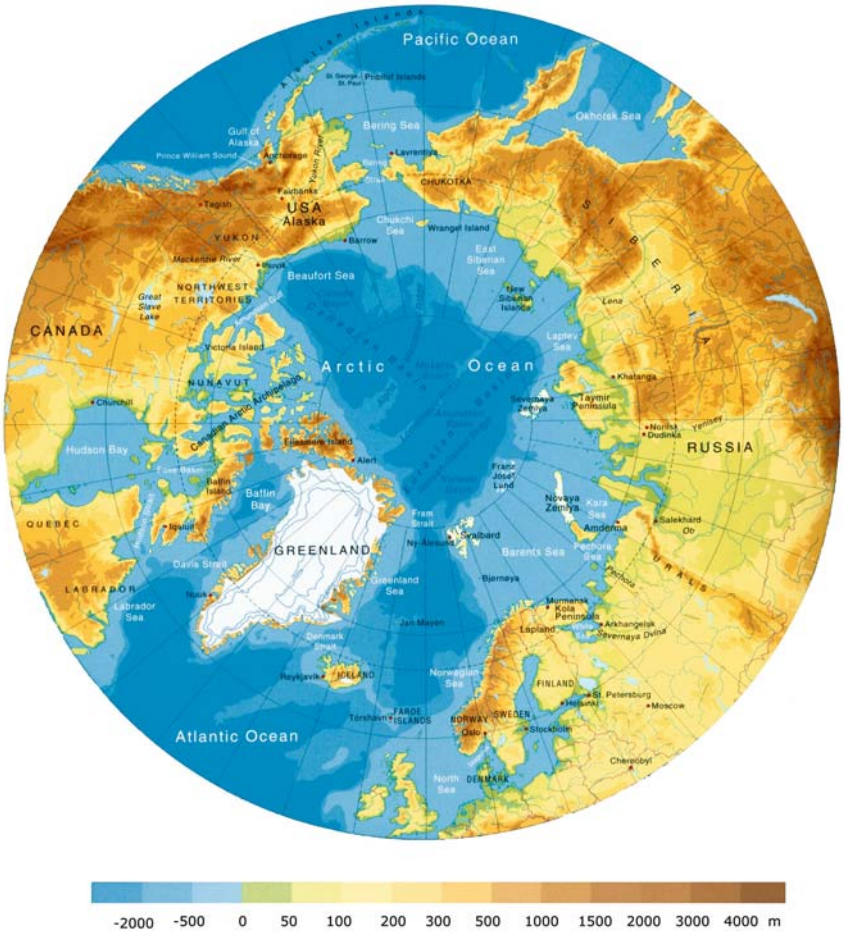
Preface

The Arctic has always attracted investigators – courageous people devoted to science. Before the 19th century expeditions were dispatched to search for new lands and to study the Arctic nature were of episodic character. The First International Polar Year (IPY) 1882/1883 was held as a result of the joint efforts of scientists from 12 countries including Russia – the basis for the observation network system in the Arctic was created. Geophysical, meteorological and some biological observations began at 13 points of the northern Polar area on a systematic basis.

The next 50 years were the time of the great expeditions and significant geographical discoveries: F. Nansen on board the ship *Fram* (1893–1896); F. Vilkitsky at the mouths of the Ob′ and Yenisey Rivers (1894–1897); E. Toll on board the schooner *Zarya* (1900–1902); B. Vilkitsky on board both the ships *Taimyr* and *Vaigach* (1913–1915); R. Amundsen and O. Sverdrup on board the ship *Maud* (1918, 1921, 1922, 1923); O. Schmidt and V. Viese on board the ice-breaking ship *Georgy Sedov* (1929–1931); and the ice-breaking ship *A. Sibiryakov* (1932); and O. Schmidt on board the ship *Cheluskin* (1933).

In 1932/1933, the second International Polar Year was held. By that time the epoch of the geographical discoveries in the Arctic was mainly completed: extensive knowledge on the nature of the Arctic and its hydrometeorological and ice regime was gained; the grounds of the hydrometeorological support system for navigation along the Northern Sea Route were created including airborne ice reconnaissance and methods of ice forecasting.

During the period of the Second IPY, the hydrometeorological network in the polar regions was significantly expanded: 115 basic stations participated from the USSR in the program with 50 of them being opened during the Second IPY. The measurements made provided new information on the characteristics and dynamics of the polar atmosphere and the ice and oceanic regime.



The area northward of 50°N.

Source: AMAP (2003).

Establishment in May, 1937, of the first 'North Pole-1' (NP-1) station in the Arctic Ocean and organization of the first 'Sever' airborne high-latidudinal expedition (AHE) continued the Second IPY in the study of the Arctic. The experience of these expeditions convincingly proved the possibility of organizing and conducting (directly from the ice) long-term complex meteorological, oceanographic and ice observations.

World War II interrupted for a long time the large-scale studies in the Arctic. The 'Sever' AHEs were resumed in 1948, and organization of drifting stations in 1950.

To date, whilst the Russian research 'NP-33' station drifts in the vicinity of the North Pole, it can be stated that our knowledge of the Arctic Ocean for the last 70 years has achieved a level differing little from the level of knowledge of the other

oceans and even exceeding it for some parameters. In the 20th century, detailed information on the seabed relief of the Arctic Ocean and its structure was obtained.

Based on these data, numerous atlases of the state of the natural environment and climate of the Arctic were prepared and published, the systems of hydrometeorological and ice support for the economic activities in the northern areas were developed and systems for remote sensing determination and monitoring of hydrometeorological characteristics in general were created including Earth satellites.

Studies showed that exactly in the polar regions global climatic changes have the largest manifestations. Significant temperature fluctuations were observed at different stages of modern evolution of the Earth's climate: cooling at the end of the 19th century, warming in the 1920s–1940s (most evident in the Arctic) and cooling in the 1950s–1970s. Significant warming has been observed during the last two decades of the 20th century, which in the opinion of a number of scientists will also continue in the 21st century.

What takes place in the Arctic? Will the Arctic ice melt? How and to what extent do the global climate changes depend on natural and anthropogenic factors?

There are so far no answers to these and other questions. That is why the International Oceanographic Commission (IOC) and the International Council of Scientific Unions (ICSU) under the aegis of the World Meteorological Organization join their efforts in holding the International Polar Year 2007/2008.

The authors hope that during this period an international drifting station will be organized in the Arctic Ocean using experience gained from Russian polar explorers.

The readers of the book will be acquainted with the brief history of establishing the drifting polar stations and the main scientific results of the analysis of meteorological, ice, oceanographic and geophysical data collected in the high-latitudinal expeditions.

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Chapter 2 'Meteorological investigations' presents the quantitative estimates and describes the main regularities of the distribution of meteorological parameters above the central Arctic basin. The Chapter is written by V. F. Radionov and V. V. Ivanov (Section 2.3) with participation of Ye. I. Aleksandrov (Sections 2.1.2 and 2.1.3), N. N. Bryazgin (Sections 2.1.4 and 2.1.6) and A. A. Dementyev (Section 2.1.5). The figures were prepared by Ye. I. Aleksandrov and V. P. Baiborodova.

Chapter 3 'Sea ice cover' was written by Z. M. Gudkovich and I. Ye. Frolov and generalizes the results of investigations of the ice cover parameters and sets forth the peculiarities of thermal and dynamic processes occurring in it. V. P. Karklin and S. V. Klyachkin also participated in the preparation of this chapter.

Chapter 4 'Oceanographic studies' was submitted by L. A. Timokhov. Individual sections were written by: G. A. Baskakov (Sections 4.1, 4.2), Ye. G. Nikiforov (Section 4.3), G. A. Lebedev (Sections 4.4.4, 4.4.6, 4.4.7), V. M. Smagin and S. V. Pivovarov (Section 4.5), and I. A. Mel′nikov (Section 4.6) jointly with B. I. Sirenko (Section 4.6.4), V. V. Petryashev (Section 4.6.4), and A. V. Smirnov (Section 4.6.4).

Chapter 5 'Geophysical observations' was submitted by A. V. Shirochkov with Section 5.3.3 being written jointly with N. F. Blagoveshchenskaya.

The conclusion was written by I. Ye. Frolov and V. F. Radionov.

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Abbreviations

AA	auroral absorption
AARI	Arctic and Antarctic Research Institute
AHE	airborne high-latitude expedition
AIDJEX	Arctic Ice Dynamics Joint Experiment (USA–Canada–Japan)
AO	Arctic Ocean
AWI	Alfred Wegener Institute
DARMS	drifting automatic radio-meteorological station
FMO	Flying Meteorology Observatory
GARP	Global Atmospheric Research Program
GCA	general circulation of the atmosphere
HF	high frequency
ICSU	International Council of Scientific Unions
INSROP	Northern Sea Route International Programme
IOC	International Oceanographic Commission
IPY	International Polar Year
LUF	lower usable frequency
MLT	Moscow Local Time
MUF	maximum usable frequency
NSR	Northern Sea Route
PCA	polar cap absorption
POLEX	Polar Experiment
RGMAA	Rossiyskiy Gosudarstvenniy Muzey Arktiki i Antarktiki (Russian State Museum of the Arctic and Antarctic)
RMSD	root-mean-square deviation
SID	sudden ionospheric disturbance
TOC	total ozone content
USSR	Union of Soviet Socialist Republics
UT	Universal Time (Greenwich)
VLF	very low frequency